Project Report: Subsurface Biospheres

Lead Team:	***University of Rhode Island***
Project Title:	***Subsurface Biospheres***
Project Investigator:	***Steven D'Hondt***

Project Progress

During this reporting period, project members collectively developed and led the first deep−sea drilling expedition to be principally focused on the exploration of life deep beneath the seafloor. Project members also undertook the first community−wide genetic assays of life deep beneath the seafloor, documented broad patterns of microbial respiration deep beneath the seafloor, tested a hypothesis of thermodynamic competition in deep subsurface communities, and used multiple molecular biomarkers to identify the members of both hydrothermal and anaerobic methane−oxidizing communities in shallow marine sediments.

Highlights

- Project members developed and led the first deep−sea drilling expedition to be principally focused on the exploration of life deep beneath the seafloor (Shipboard Scientific Party, 2002; D'Hondt et al., 2002a). Microbial cells and a range of metabolic activities were discovered in all sediments at all depths.

- Project members undertook the first community−wide genetic assays of life deep beneath the seafloor (Kormas et al., 2002). This study of selected samples from a western Pacific drillsite suggests that subseafloor communities are not simply buried oceanic communities and that distinct communities occur at different sediment depths.

- Project members compiled 25 years of deep−sea drilling data to document global patterns of metabolic activity deep beneath the seafloor (D'Hondt et al., 2002b). The study showed that the metabolic rates of subseafloor life are generally orders of magnitude lower than those of life on Earth's surface.

- Project members collaborated closely with Marine Biolological Laboratory (MBL) Team members in using multiple biomolecular approaches to document the microbial diversity of anaerobic

methanotrophic communities in near−surface marine hydrothermal sediments (of the eastern Pacific Guaymas Basin) (Teske et al., 2002).

- Project members are actively testing thermodynamic hypotheses of microbial competition in deep subseafloor environments (Spivack et al, 2002). Their initial results suggest that in subseafloor sediments, hydrogen concentrations are fixed at the lowest concentrations that provide sufficient free energy for hydrogen−using metabolic reactions to proceed.

Roadmap Objectives

- ***Objective No. 6:*** Microbial Ecology
- ***Objective No. 7:*** Extremes of Life

Field Expeditions

Field Trip Name: Subseafloor Biosphere Ocean Drilling Program (ODP) Leg 201	
Start Date: 02/01/2002	***End Date:*** 03/31/2002
Continent:	***Country:***
State/Province:	***Nearest City/Town:*** Lima
Latitude: 3°N to 12°S	***Longitude:*** 78°W to 112°W
Name of site(cave, mine, e.g.): ODP Sites 1225−1231	***Keywords:*** Pacific, subsurface life
Description of Work: In water depths as great as 5300 meters and as shallow as 150 meters, the expedition drilled up to 420 meters into oceanic sediments and the underlying rocky crust. Team members and collaborators undertook microbiological, biogeochemical, sedimentological and geophysical studies of the microorganisms within these sediments and crust and the environments that they inhabit.	
Members Involved: Steven D'Hondt, Kai Hinrichs, David Smith, Arthur Spivack, Andreas Teske.	

Cross Team Collaborations

Penn State Team Member Christopher House participated as a microbiologist on the deep−sea drilling expedition. He led many of the expedition's microbial contamination experiments and is playing a key role in post−cruise biological studies of this deeply buried life. House and University of Rhode Island (URI) Team member Hinrichs have also collaborated closely with others in documenting the composition and structure of anaerobic methane−oxidizing microbial communities in near−surface marine sediments.

MBL Team member Mitch Sogin and his close associates provided analytical facilities and advisory expertise necessary for our year−4 genetic assays of life deep beneath the seafloor (at the western Pacific Nankai Margin). URI and MBL Team members have also collaborated closely in using multiple biomolecular approaches to document the microbial diversity of anaerobic methanotrophic communities in near−surface marine hydrothermal sediments (of the eastern Pacific Guaymas Basin).